



Centre Français sur les Etats-Unis (CFE)

## **The Private Sector Road to a Space-faring Civilization**

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Nearly four decades ago, the movie “2001: A Space Odyssey” presented a vision of private flights to private hotels in a giant, orbiting space station, with regular transportation to thriving bases on the Moon. The year 2001 is past and only about 500 human beings have ventured into space. A station, begun by America’s National Aeronautics and Space Administration, is decades behind schedule and tens of billions of dollars over budget. America’s shuttle program is in shambles. And no human beings have walked on the Moon for over 30 years.

The reason that human beings have made comparatively little progress in space since the days of the lunar landings is that governments rather than the private sector have dominated space-related activities. In the future, if human beings are to create a true, space-faring civilization, governments will need to step back and let entrepreneurs rather than bureaucrats lead the way.

### **The Lessons of History**

Today’s prejudice in favor of government space activities had its origins in the two different paths of development of aviation and rocketry. Individual entrepreneurs pioneered aviation. A century ago the Wright brothers flew the first powered airplane. In the decades that followed private individuals and companies, in the United States, France and elsewhere, continued to develop aircraft. Private prizes offered to innovators

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often spurred these developments. Best known was the \$25,000 prize put up by Raymond Orteig, a French immigrant to the United States, to be paid to the first person to fly across the Atlantic. Charles Lindbergh won that prize in 1927. The American government helped the civil aviation sector but in a unique way. The government was responsible for delivering the mail. Rather than purchasing aircraft and hiring pilots, the Post Office contracted with private pilots – Charles Lindbergh was one of them – to fly mail routes. This contracting policy created incentives for more investment in civilian aircraft.

In addition to this civilian side of aviation there was a defense side as well. In the early days of aviation the American government also used prizes to obtain technology that it needed for military aircraft. With World War Two and the Cold War the American government spent billions of dollars on military aircraft. This spending helped the civilian sector indirectly. But a separate civilian aviation sector always remained and was never absorbed by the government. While governments owned the airports and the air traffic control system, the private sector provided the flights for civilian travelers. The routes and rates for travel initially were heavily regulated. But deregulation of air travel in 1978 caused the price of traveling to drop by at least one-third. The number of trips taken by Americans rose from 275 million in 1978 to 650 million in 2000.

Individual entrepreneurs pioneered rocketry as well, starting with the 1926 launch by Dr. Robert Goddard of the first liquid fuel rocket. The private Guggenheim Foundation, which included Charles Lindbergh as one of its directors, gave money to Goddard in the 1930s for his work.

After World War II, the Pentagon brought Werner von Braun and a team of scientists from Germany to the United States to develop more advanced designs of their V-2 rockets. With the launch of Sputnik by the Soviet Union in 1957 the American government became heavily involved in both defense and civilian space activities. In other words, unlike the situation with aviation, civilian space activities were mostly absorbed by the government. Market forces did not operate in this sector.

### **The High Costs of Government Space Activities.**

The American landings on the Moon were motivated first by a desire for national prestige, to show the world that the American government, science and culture were superior to those of Communist Russia, which had launched the first man into space in 1961. It is questionable whether the geo-political landscape would have been different if the United States had chosen not to engage in a space race or if the Soviet Union had landed on the Moon first. Other factors, most notably the Vietnam War, the Sino-Soviet split and the oil crisis, were much more important than space ventures.

The federal government had legitimate defense reasons for investing in space-related activities. Intercontinental missiles and spy satellites turned out to be crucial for the military. But in the early 1960s it was not clear which other capacities, for example, a capacity to work and live in space, might have defense application in the future. Thus it could be argued that to be safe, America should develop such capacities. And why not give those efforts added value through an inspiration achievement: landing men on the Moon?

The American government spent billions of dollars over an eight-year period to achieve this goal. Could the private sector have done this? No, not in this short period of time and not at that high cost. But because the government wanted to land men on the Moon quickly, the costs were much higher than they needed to be. As a result, after only six landings the expensive program was cancelled and human beings have not returned to the lunar surface since 1972. If a slower approach had been taken, the costs might have been lower and we might have established permanent bases.

Could the private sector have financed trips to the Moon with little or no government help? Perhaps, but only over a longer period of time. Private commercial firms as well as non-profit organizations and foundations have an admirable record of promoting scientific research as well as science that has commercial applications. For example, the Carnegie Foundation spent \$2.29 million between 1920 and 1929 on the largest telescope in the world at that time – with a 100 inch mirror --- on Mt. Wilson; \$2.38 million from 1930 to 1939; and \$2.15 million between 1940 and 1949. Beginning in 1929 the Rockefeller Foundation spent \$6 million to build the Mount Palomar Observatory, which took the title for having the world's largest telescope – 200 inches – when it saw first light in 1948.

These amounts might seem small compared to the astronomical costs of space travel. But costs are usually high because the government is providing the good or service. Consider an example: William Haynes of the Scientific Applications International Corporation in the 1980s tells us that NASA had considered developing a space pod for orbital construction similar to the one seen in the movie "2001: A Space Odyssey." The cost estimate for the system, which was never built, was over \$1 billion. However, at the same time oceanographers were developing a very similar vehicle to operate in the dangerous environment of the ocean floor. But "Deep Rover," as the vehicle was called, was privately developed by the individuals who would risk their lives in the vehicle in the depths of the sea. The cost was only \$1 million.

Consider another example: When the first President Bush declared in 1989 that Americans should land humans on Mars, NASA estimated the cost of a mission at \$450 billion – too expensive for the Bush administration and Congress at that time. Believing that a less costly mission was possible, then-Martin Marietta engineer Robert Zubrin devised an innovative mission design. For example, one of the most costly aspects of space travel is carrying the heavy fuel. Zubrin saw that rather than carrying return fuel to Mars, an unmanned ship could land there first with a simple chemical laboratory to manufacture methane and oxygen (i.e., rocket fuel) out of Mars' carbon dioxide atmosphere. Using NASA's methods for determining costs, Zubrin's approach would cost between \$20 billion and \$30 billion, some 95 percent less than the government approach.

### **The Shuttle and Station Problems.**

The high cost of government space activities continues to chain humans to the Earth. For example, the space shuttle was supposed to bring down the cost of access to space with 50 launches per year. Instead the Shuttle averaged four launches annually. While costs are difficult to calculate, one estimate suggested that in the early 1990s the cost of putting a pound of cargo in orbit on the Shuttle was about \$6,000 in real dollars, compared to only \$3,600 on the Saturn 5 rockets that put men on the Moon. Duke University Professor Alex Roland maintained that the cost was as high as \$35,000 per

pound. And since two of the five vehicles were destroyed in tragic accidents, the costs are certainly high, no matter what method of calculation is used.

In the mid-1980s, when planning began, the American space station was supposed to cost \$8 billion, accommodate a twelve-person crew, and be in orbit by the 1990s. But the station was redesigned many times, its size reduced, and international partners brought into the project. By 1995 one report by the U.S. government's General Accounting Office found that, through June 2002, the actual cost of designing, building, and launching the station would be \$48.2 billion. The cost of operating the station after its assembly through 2012 will add another \$45.7 billion to the price tag for a total bill of \$93.9 billion. Now estimates put the final cost of the station even higher.

What is worse is, the station can only accommodate a three-person crew and two crew members are necessary just to maintain it. In other words, there is little time to do science on the station. Worse still, the station is not a step towards some less costly way to open space to commercial development. The station is a dead end.

The current President Bush recently announced a new direction for NASA. He said it should be America's goal to return to the Moon and eventually land humans on Mars. One reaction to this plan is, "Great! It's about time NASA stopper literally going around in circles in low Earth orbit and return to its original mission of science and exploration." But it is doubtful that NASA in its current shape will be able to achieve these goals.

At this point NASA has no plan by which to meet these goals and continued construction of the station simply drains funds that might go to other uses. Further, NASA's announcement that it will no longer service the Hubble Space Telescope, probably the most scientifically important instrument developed after the Apollo Moon landings, and let the Hubble fall into disuse shows that NASA managers still have no sense of priorities.

### **Privatization and Commercialization.**

The only way that humans will develop a space-faring civilization is if the private sector, both non-profit organizations and, especially, commercial enterprises, lead the way. Only the private sector can commercialize goods and services, that is, bring the price down and improve quality to make them accessible to all people. Whether cars, computers, or airline flights, private entrepreneurs investing their own funds and competing with others create the wealth that makes countries and individuals truly prosperous. Sometimes governments might develop the initial technology. For example, the Pentagon developed the basic technology for the Internet. But private entrepreneurs created the omnipresent 'Net that we know today and priced it so that everyone in the industrialized world can have access.

The essential element for any free market is individual private property rights: the liberty to acquire material and non-material goods and services through voluntary exchange with others; the liberty to use those goods as the owners see fit, without the permission of others; and the liberty to dispose of the property in exchanges with others based on the mutual consent of buyer and seller. The free market is simply the activity that occurs as individuals acquire, use and disposed of property. Contracts, for example, are agreements concerning the use and exchange of property. Prices are the terms of exchange. And the role of government in a society based on individual liberty and

property rights is not to limit the liberty of owners, regulate the use of property in light of their own prejudices or control the terms of exchange; it is to protect those liberties and that property.

Property owners have an incentive to make the best use of their assets. Consider government waste versus property incentives: Each Shuttle has a 150 ft. tall external fuel tank. A Shuttle flies 98 percent of the way to orbit with its tank. Once the nontoxic liquid oxygen and hydrogen from those tanks burn off, the tank is dropped into the ocean. If the Shuttle were privately owned, the owners would not be eager to destroy a \$40 million piece of equipment with each launch, and owners might place each tank in orbit. If this had been done since the beginning of the Shuttle program, there would be about 100 tanks in orbit --with over 12 hectares of interior space, about the size of the entire floor space of the Pentagon--waiting to be sealed and "homesteaded" by private owners for scientific experiments, space hotels, honeymoon suites, or any other activity of which an entrepreneur could conceive. This would not be the first time such a concept was used. In the 1970s NASA used a tank stage of a Saturn V for the Skylab.

The most commercially successful part of the space sector – communications satellites - - is that part dominated by private companies. The Satellite Industry Association estimates that worldwide satellite industry revenues was about \$90 billion in 2001, up from \$83 billion in 2000 and \$69 billion in 1999 with the American portion currently valued at \$37.5 billion. SIA estimates that there are 253,600 jobs in that industry worldwide, up from 205,400 in 1999, with 136,500 Americans employed. The Space Transportation Association Chairman Tidal McCoy puts the number of employees in space-related industries at 497,000. There is also a healthy private American launch industry, with Boeing, Lockheed Martin and Orbital as the principal suppliers. It is interesting to note that starting in the 1970s private companies were asking NASA to contract out to them for launch services – the way the Post Office contracted for mail transportation – but instead, the U.S. government, until the Shuttle Challenger disaster in 1986, actually banned government cargos from private rockets.

The X-Prize Foundation of St. Louis is using one of the most promising private approaches to promoting private space activities. It has raised \$10 million to award to the first entrepreneur who sends a craft capable of carrying three persons at least 62 miles into space and return it to Earth twice in a two-week period. There are a number of credible teams seeking this prize. The first contender to test a vehicle that could go for the gold is Burt Rutan. And on December 17, 2004, the centennial of the Wright brothers' first flight, his test vehicle acceded the speed of sound over the desert in California. Rutan designed the Voyager, first plane to fly around the world nonstop, without refueling, in 1986.

One of the most successful companies supplying services for companies wanting to exploit space as well as for NASA is SpaceHab. When a company or research organization wishes to utilize space, it cannot simply throw an experiment into the cargo bay of the Shuttle or place it in a container atop an expendable launch vehicle. Payloads must be carefully package and each one has special environmental and energy needs. SpaceHab developed modules for payloads that can be carried in the Shuttle's cargo bay and that can accommodate a variety of experiments.

An entrepreneur who could make the need for government space stations unnecessary is Robert Bigalow who is spending \$500 million to manufacture and orbit a private space

station. It will be made out of inflatable structure made light-weight but rugged materials. A material like Kevlar weighs a fraction of the cost of metal being used in the International Space Station (ISS) but is strong enough to take a bullet or a micro-meteor. Thus the cost for such modules should be much lower than for the ISS. Bigelow hopes to orbit in three launches the same amount of interior space that it will take 30 to 40 Shuttle launches to put up with the ISS.

Space tourism might become “killer application” that will offer opportunities and incentives to the private sector to develop low-cost access to space and platforms in orbit to which private adventurers can go. The winner of the X-Prize no doubt will attempt to develop a business that offers suborbital trips into space. And private American businessman Dennis Tito paid the Russians a reported \$20 million, as did South African Mark Shuttleworth, for trips to orbit. Some estimates show that individuals today would spend about \$1 billion for flights into space if they were available. Of course, as the \$20 million price tag drops, the demand and potential revenue would increase. The private company Space Adventures already offers an array of space-related activities, including tours of space facilities or sites on Earth, stargazing, and even flights on training planes like those used by astronauts to simulate weightlessness. It will no doubt work with private launch companies in the future to add trips into space to its services.

## **What is Needed.**

### *Property Rights.*

Commercialization and true prosperity relies foremost on private property rights. But can there be such rights in Earth orbit or on other heavenly bodies? The Outer Space Treaty of 1967, which was signed by the major space powers, was drawn up when the governments that negotiated it pictured only governments as parties operating in space. Thus, for example, the treaty made governments liable for damage done by rockets launched from their territory. The treaty also states that:

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

But this definition does not exclude the use of space by private parties. Further, the treaty allows that parties be free to operate in space without the interference of other parties. This principle potentially allows for quasi-property rights, a kind of common law regime, or at least the beginnings of such a regime. It will probably be necessary for governments to amend the treaty or the private sector simply to ignore it if other worlds are to be colonized.

The International Telecommunications Union regime, endorsed by most governments, essentially bars official property rights for orbital slots. But it has created a kind of quasi-rights regime that has allowed the satellite industry to develop. For geo-stationary satellite slots using the C-band, there was a kind of “you use it first, it’s yours” approach. A private party could appropriate a slot by publishing in advance their intent to use it, coordinating with other parties to make certain that there would be no interference with their activities, and notifying the ITU. While this regime allowed the most advanced parties and countries to place satellites in orbit, one problem was that parties would

announce plans to use certain slots as a way of holding them when they did not intend to use them in the near future if ever. Less developed countries also complained that they would never be able to obtain slots since richer countries would get all the good ones. What happened is that poorer countries were able to claim certain slots and then, in effect, rent or sell them to parties that wanted to use them.

In the future, some sort of change might need to be made to the ITU to allow for real property rights in orbit. This might be necessary because of the advanced, multiple uses of low Earth orbit. Disputes in such cases might be handled by the ITU or perhaps a quasi-private adjudication regime might emerge.

#### *NASA and Privatization.*

To meet President Bush's goal of returning to the Moon and going to Mars, radical changes in NASA are necessary. To begin with, NASA should be strictly limited to science and exploration and it should be required to purchase most of the services it needs from the private sector. Many of NASA's functions should be abandoned or turned over to other government agencies. For example, if the government wants to continue satellite studies of the climate and resources, those functions should be turned over to other agencies like Environmental Protection Agency and Interior Department and those agencies should be required to purchase the data – not satellites -- from private suppliers.

Other NASA operations should be privatized. The Shuttle, if it is every to fly again, should sold or even given away to private owners; the United Space Alliance, the joint venture between Boeing and Lockheed-Martin that refurbishes the Shuttle between flights, would be an obvious candidate. Let a private owner fly it for paying customers – including NASA if necessary – if it is still worth flying.

NASA also should give up the money-draining space station, and sooner rather than latter. The station might be turned over to the international partners or, better still, to the mostly private Russian rocket company, Energia, and the western investors who were in the process of commercializing and privatizing the Mir space station before the Russian government brought it down for political reasons. If need be, NASA can be a rent-paying station tenant.

#### *Regulatory Changes.*

To make space truly part of mankind's domain a number of policy changes in the United States will be necessary. For example, in 1998 a law transferred jurisdiction over exports from the Commerce Department to the State Department, which has been much stricter and slower in approving exports, which has harmed the ability of American firms, especially satellite manufacturers, to work with Russian, European and other partners. This law is harming the private space sector in general and certainly will hinder the emergence of private space travel. Also the time and costs necessary to secure government approval to launch a private rocket will need to be reduced from the current six months.

The U.S. government can remove other barriers to space enterprise. For example, it could creating enterprise zones in orbit that would help make up for government errors

of the past. Congressman Dana Rohrabacher proposes a “Zero Gravity, Zero Tax” plan that would remove an unnecessary burden from out-of-this-world” risk-takers.

Or consider a radical approach that could help meet President Bush’s goal of returning humans to the Moon. Former Congressman Bob Walker suggests that the federal government would not need to spend any taxpayer dollars if it gave the first business to construct a permanent lunar base with its own money a 25-year exemption from all federal taxes on all of its operations, not just those on the Moon. Think of all the economic activity that would be generated if a Microsoft or General Electric decided to build a base! And the tax revenue from that activity probably would offset the government’s revenue losses from such an exemption.

### **Space: The Human and Free Market Frontier.**

The desire to explore other worlds is a manifestation of humanity at its best. The lunar landings were the realization of a dream dreamt since our prehistoric ancestors on warm savannas or in cold caves first gazed at the lights in the heavens and wondered what they were. The moon, so large and bright like a beautiful goddess in the night sky, held a special fascination for our ancestors. Greek thinkers speculated that it might be not some celestial goddess but another world. In 1609 Galileo confirmed with understanding. From then on men mused about what was considered forever unattainable, a journey to the moon.

But in the 20th century, human beings exemplified the best within them by making that dream a reality. Aristotle was right to say, "All men by nature desire to know." We traveled to the Moon. The philosopher Ayn Rand wrote of the first landing that “The most inspiring aspect of Apollo 11’s flight was that it made such abstractions as rationality, knowledge, science perceivable in direct, immediate experience. That it involved a landing on another celestial body was like a dramatist’s emphasis on the dimensions of reason’s power.”

But with free finds must go free markets. The human adventure will only continue is policymakers unleash the energy and creativity of entrepreneurs so that they can go in space what they have done on Earth; make it a prosperous place for all mankind.